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MATERIAL OPTIMIZATION OF AUTOMOBLIE MASTER CYLINDER

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Abstract— In the whole vehicle frameworks the braking mechanism is the key part. Just as out of the diverse braking mechanisms the hydraulic braking mechanism is gives great execution. In hydraulic braking mechanism the significant segment is oil chamber, which controls the total braking mechanism. The oil chamber is supply comprised brake liquid. As the driver applying brake pedal, the oil is compressed then the pressure builds up in the brake chamber. Due to this exerted pressure the braking mechanism is activated.

This paper presents, we are going to design an oil chamber to optimize the master cylinder *by* ***utilizing CATIA AND ANSYS. Additionally the warm examination is done to discover the transition and the warm pressure utilizing various materials.***

Keywords— Automobile Braking System, Master Cylinder, Oil Chamber, Thermal and Structural Analysis, CATIA and ANSYS

I. INTRODUCTION

In the automobile hydraulic braking system, the master cylinder is an important control device that converts pedal force (commonly from a driver's foot) into pressure.

Due to the movement of piston in the master cylinder bore, the hydraulic fluid pushed the slave cylinder. The hydraulic pressure created by moving a piston toward the slave cylinder the amount of force and displacement applied to each slave cylinder, relative to the amount of force and displacement applied in the master cylinder.

By making the vehicle is lighter weight, it will improve the performance and handling of vehicle. Many of the manufacturers are focused on lighter material to the body panels and parts for reducing the weight of the vehicle. In past years, many of manufacturers the vehicle body panels and parts are produced using cast iron only but in this days it will replaced by Al alloys, magnesium and titanium. Since they offers lighter weight compared to the CI. As we know that, the vehicle is connected to surface of the road through the tires by the traction force. This small tire tread area contacting the road surface area generates braking, steering or acceleration force. The most important and needful safety components that will helps to avoid accidents are breaking system and the tires and steering system. The brake system must be operates in efficiently for all the conditions like slippery, wet and dry roads.

II. LITERATURE REVIEW

Eichhorn Lane, E Owen, Ken Layne, and Jack Erjavec presented in 2001(9), some of the vehicle brake systems are operated by single master cylinder unit until the 1967, after several years the manufacturers added the dual tandem master cylinder for the improved safety of the vehicle. The diagonally split Hydraulic master cylinder was founded by Daimlerchrysler in the year of 1978, which is successfully incorporated with all the vehicles in now a days. James D.Halderman, 1996 (8) presented the constructional utilization with two different materials. The body is made of AL alloys and plastic materials are used for reservoir. C. J. Buynacek and W.L.Winterbottom(2) High Volume Semi-Solid Forming the Al Master Cylinders (2000-01-0060) written by C.J.Buynacek and W.L.Winterbottom, the feature design and development of semi-solid metal AL master cylinders to vehicle applications. This is also helps to continue research on reducing the weight of the vehicle and improves the design by changing the material.

III. DESIGN TOOLS

III.I. Engineering Design

CATIA V5 offers a range of tools to enable the generation of a complete digital representation of the product being designed. A number of concept design tools that provide up-front Industrial Design concepts can then be used in the downstream process of engineering the product. These range from comprehensive freeform surface tools

IV. METHODOLOGY

MODELING AND DESIGN OF MASTER CYLINDER

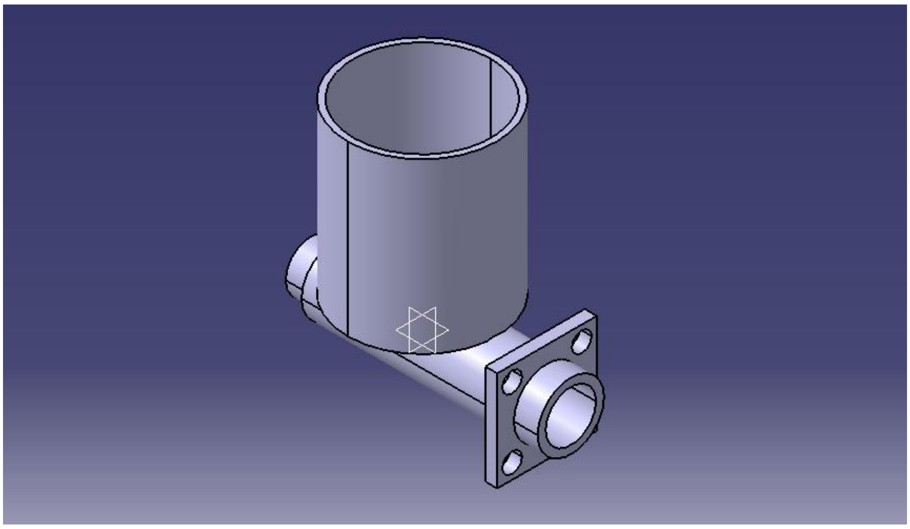


Fig . Model of Master Cylinder

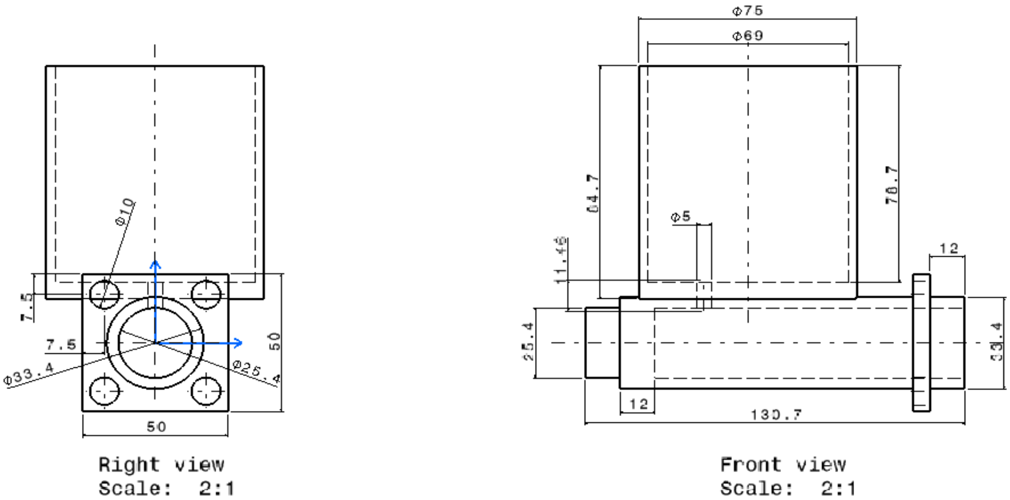


Fig. Drafted front and right side view

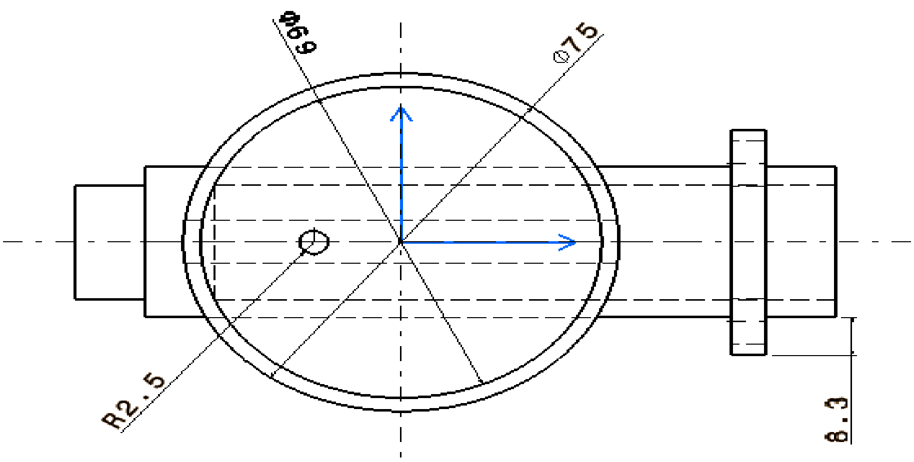


Fig. Drafted top view of master cylinder

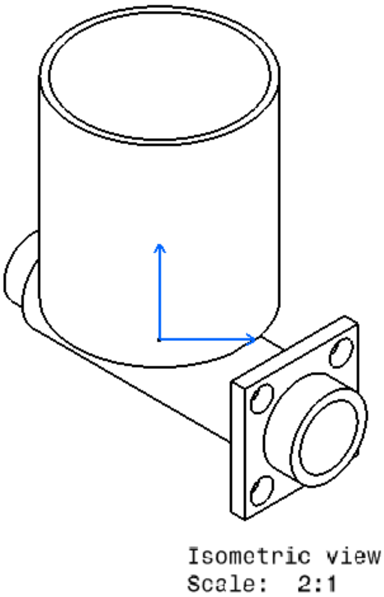
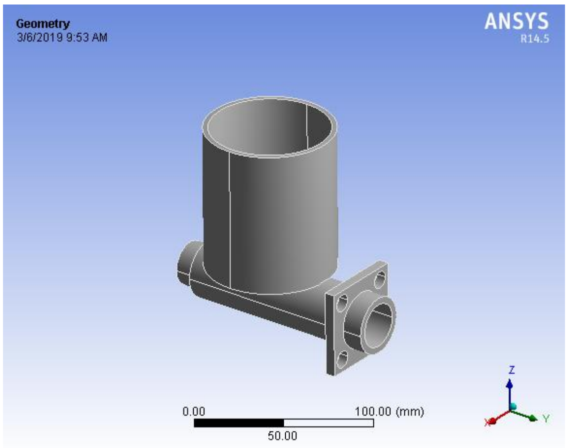
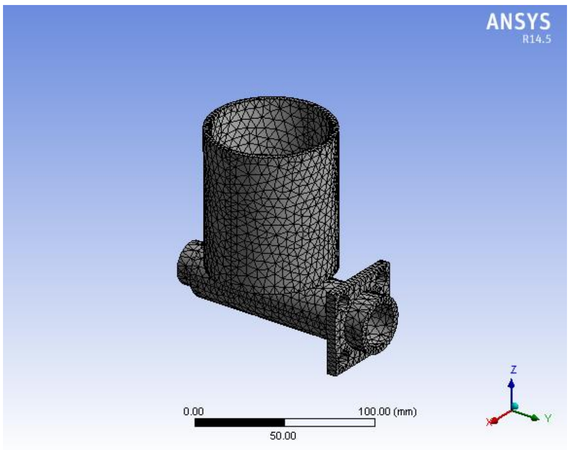


Fig. Isometric view of master cylinder

V. THERMAL ANALYSIS OF MASTER CYLINDER

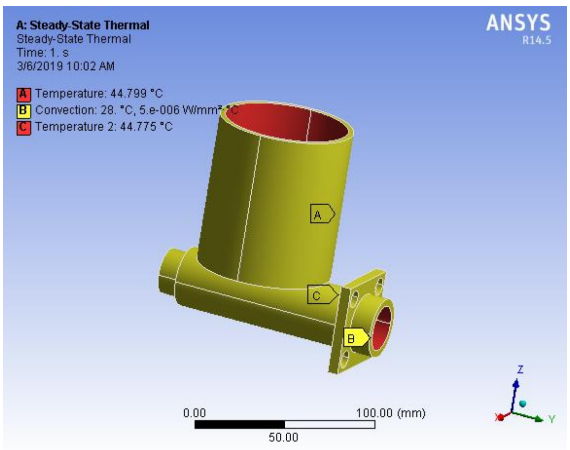


GEOMETRY MODEL IMPORTED IN TO ANSYS



MESHED MODEL OF MASTER CYLINDER

DIFFERENT INPUT PARAMETERS CONSIDERED IN THERMAL ANALYSIS FOR ANSYS



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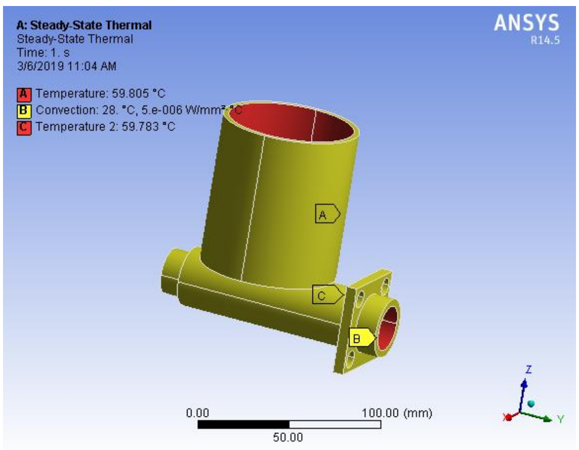

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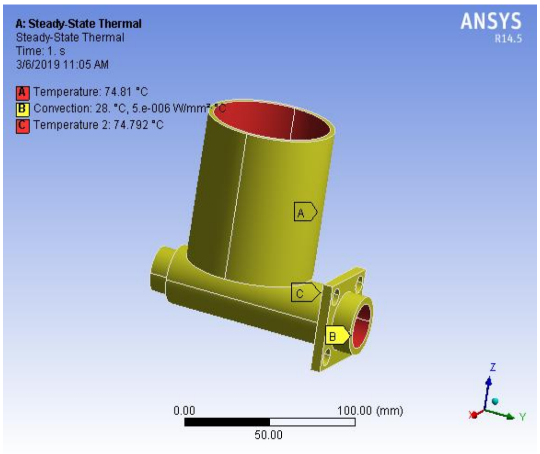
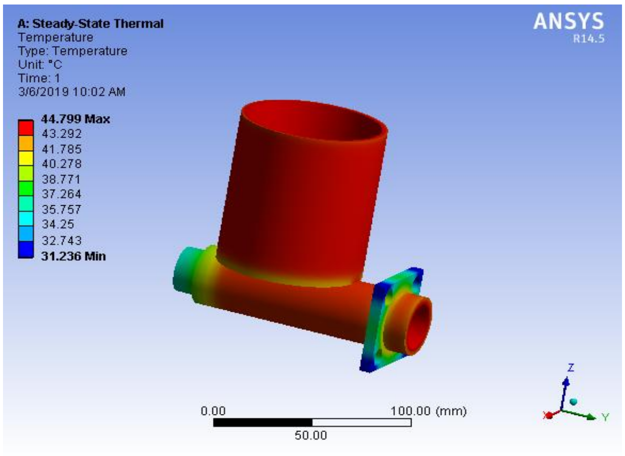
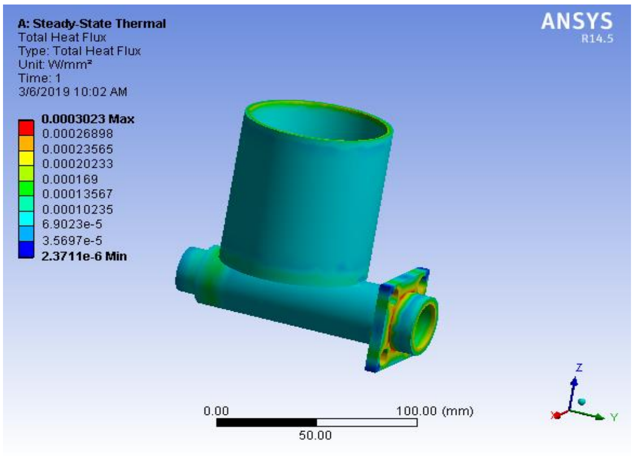


PARAMETER – 3

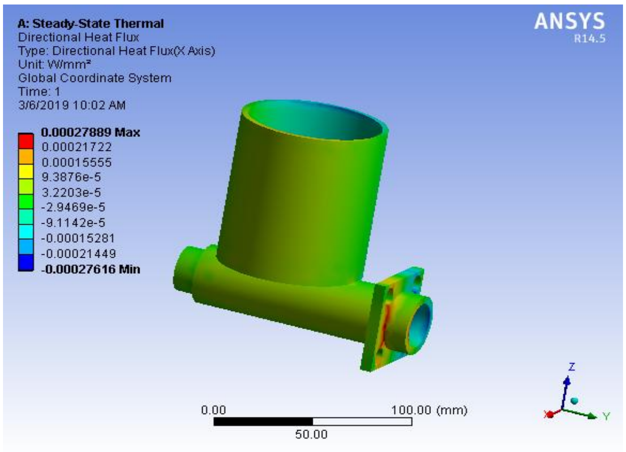
ANSYS RESULTS FOR THE ACETLY POLYMER FOR PARAMETER 1



TEMPERATURE



TOTAL HEAT FLUX



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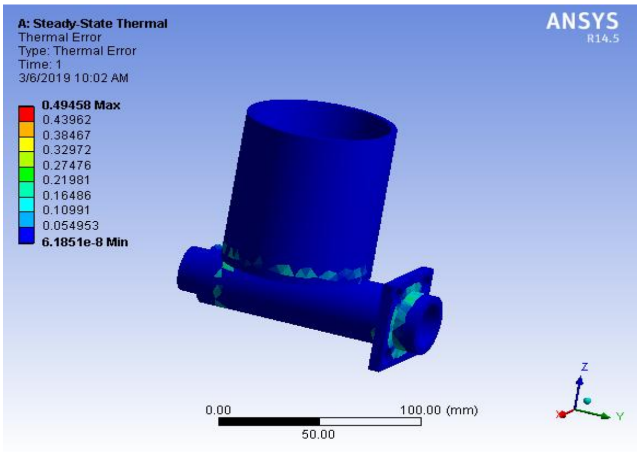

THERMAL ERROR

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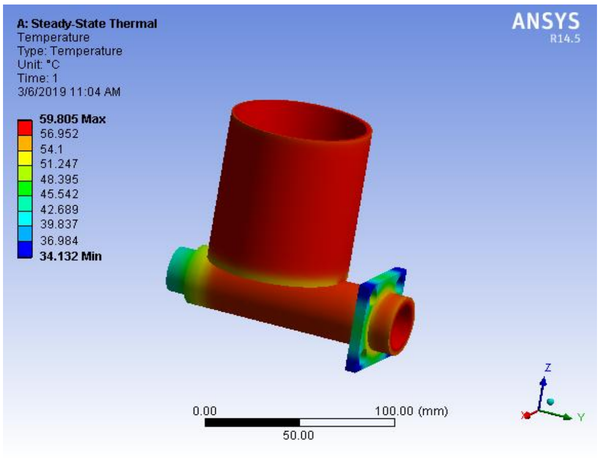

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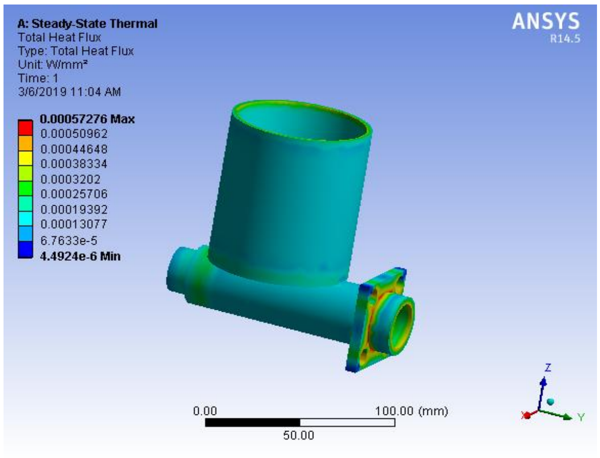

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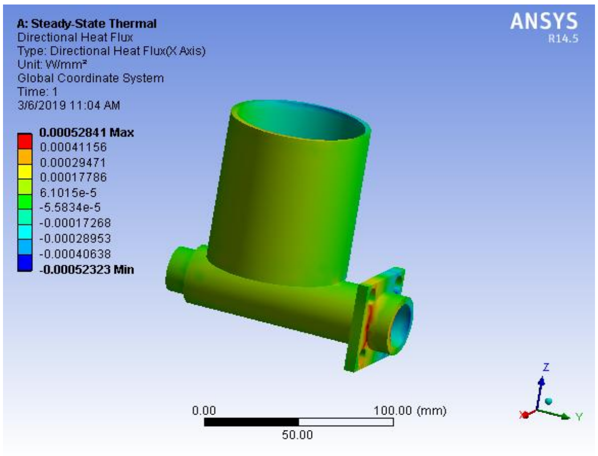
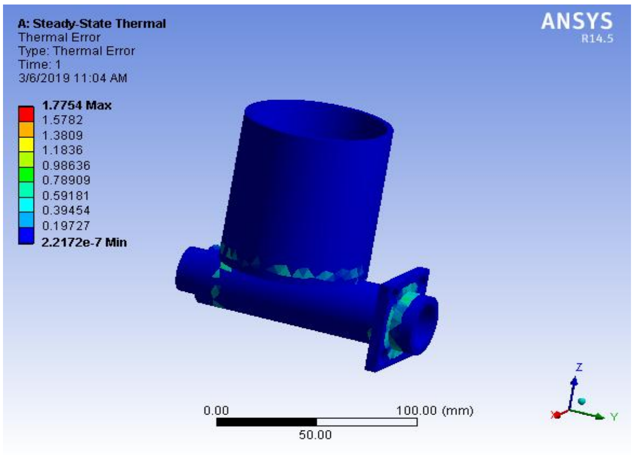
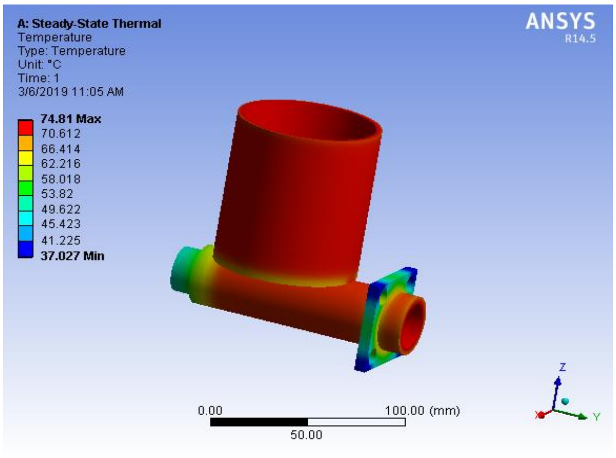




DIRECTIONAL HEAT FLUX THERMAL ERROR

ANSYS RESULTS FOR THE ACETLY POLYMER FOR PARAMETER 3



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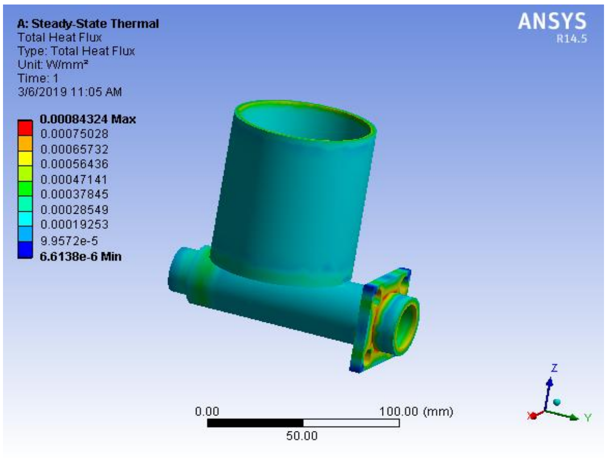

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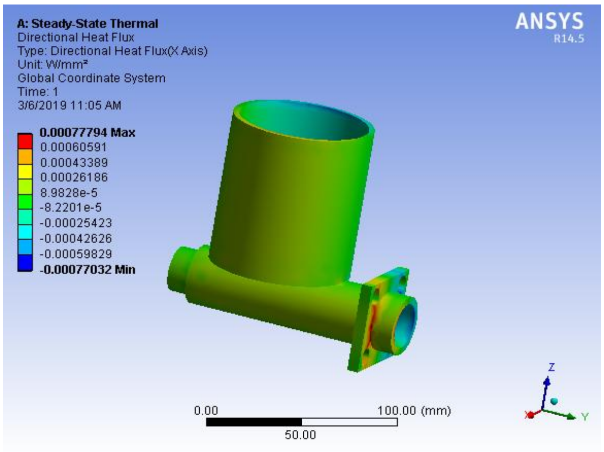

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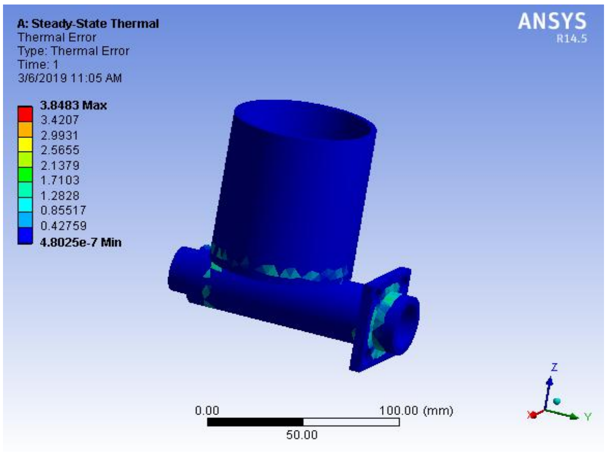
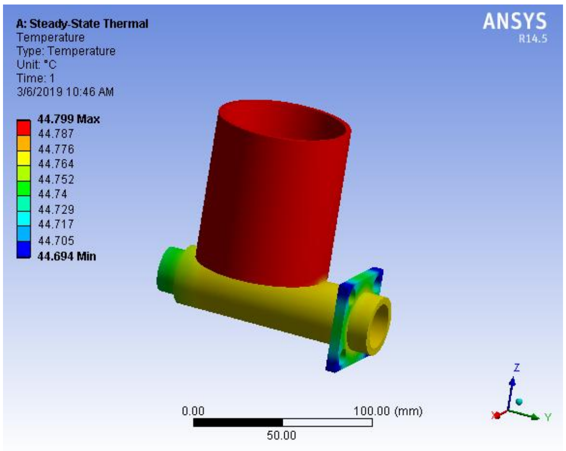


THERMAL ERROR

ANSYS RESULTS FOR THE AL 2024 FOR PARAMETER 1



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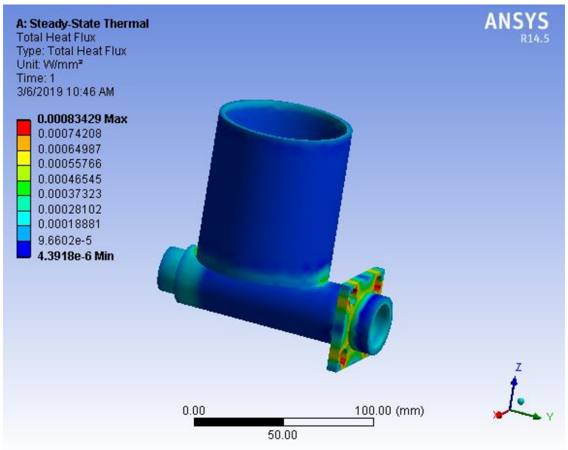

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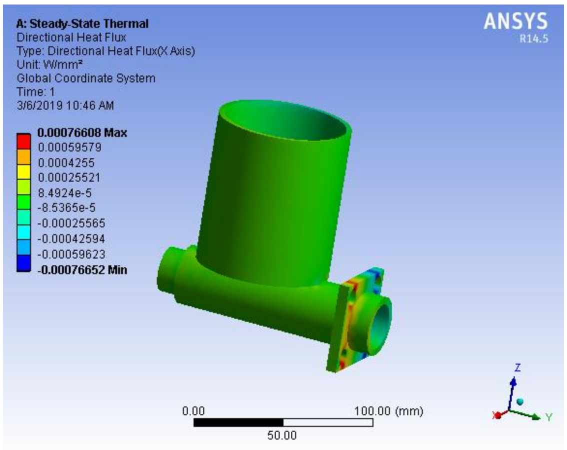

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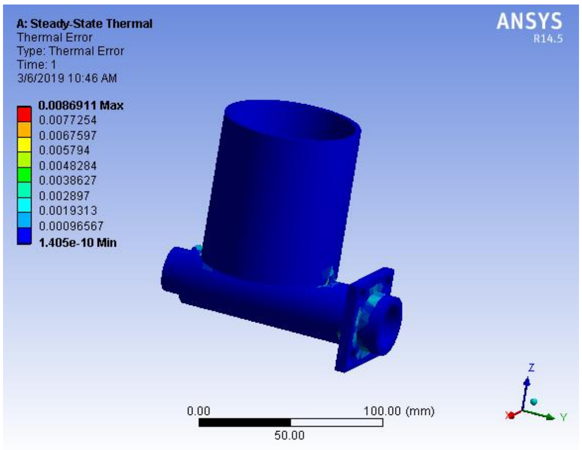
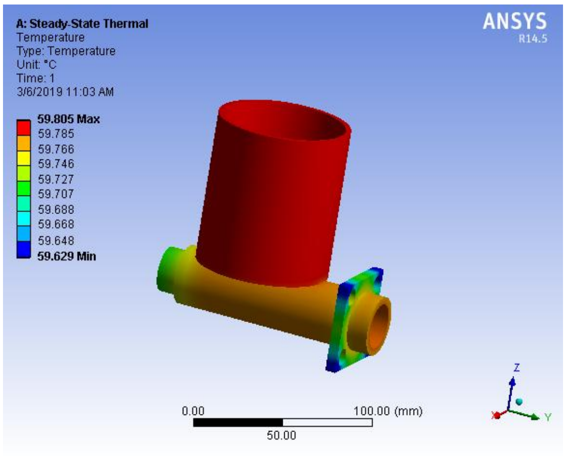


THERMAL ERROR

ANSYS RESULTS FOR THE AL 2024 FOR PARAMETER 2



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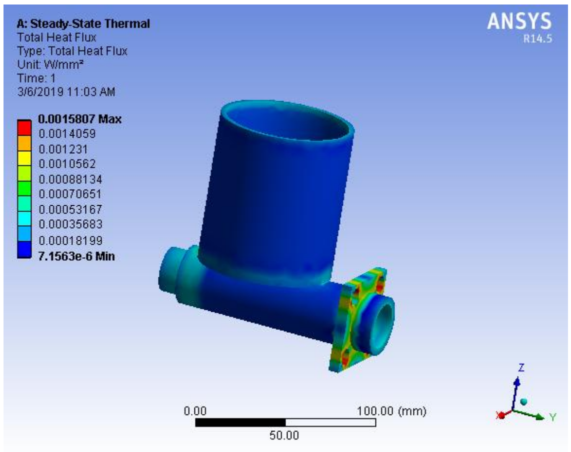

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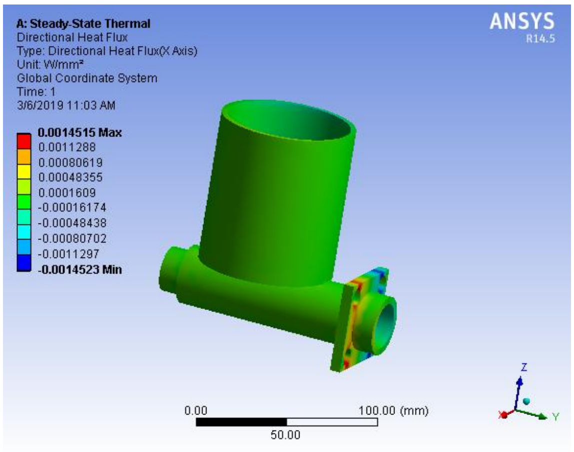

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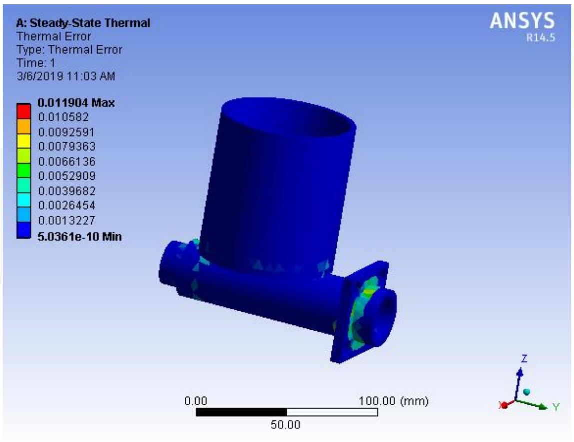
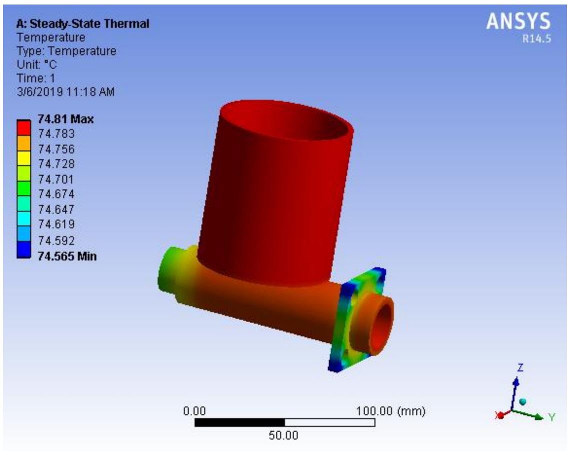


THERMAL ERROR

ANSYS RESULTS FOR THE AL 2024 FOR PARAMETER 3



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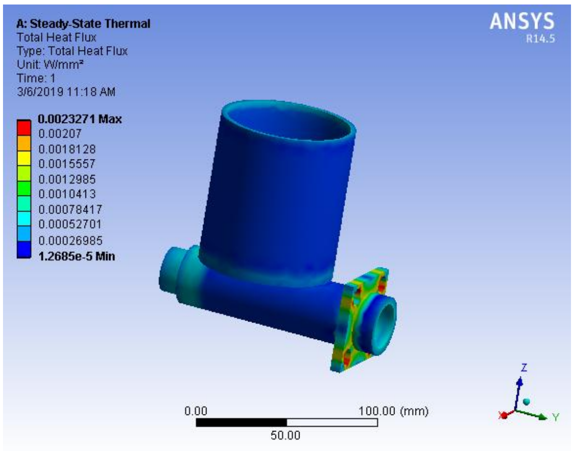

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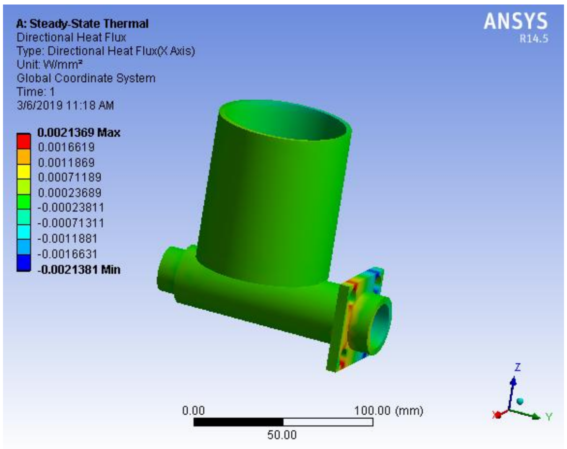

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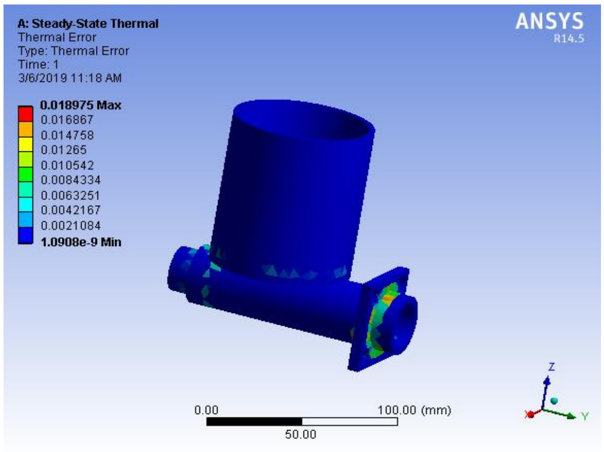
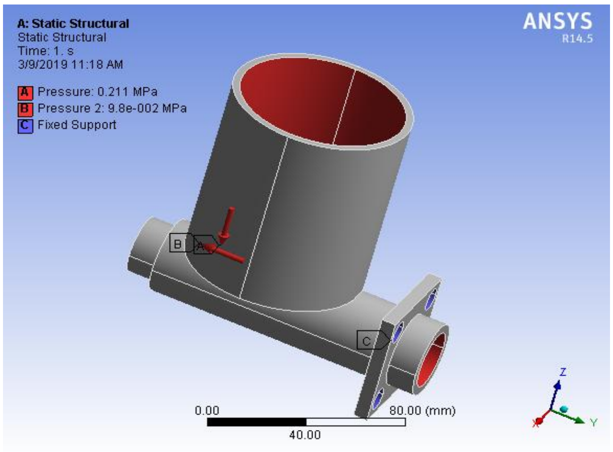


THERMAL ERROR

VI. STRUCTURAL ANALYSIS OF MASTER CYLINDER

DIFFERENT INPUT PARAMETERS CONSIDERED IN STRUCTURAL ANALYSIS FOR ANSYS



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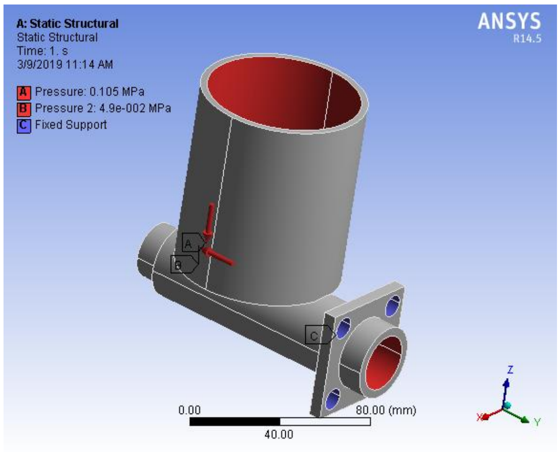
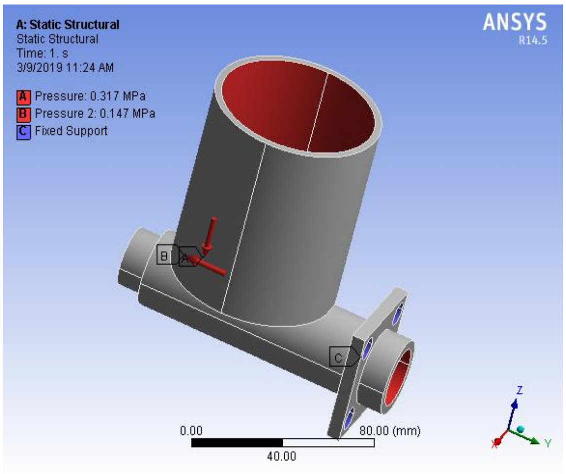


PARAMETER – 2



PARAMETER – 3

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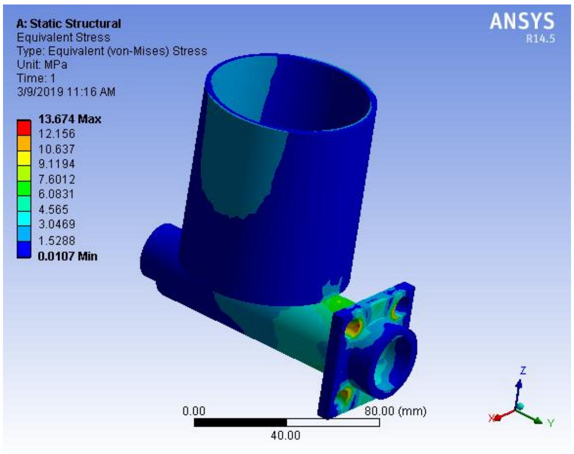
ANSYS RESULTS FOR THE ACETYL POLYMER FOR PARAMETER 1



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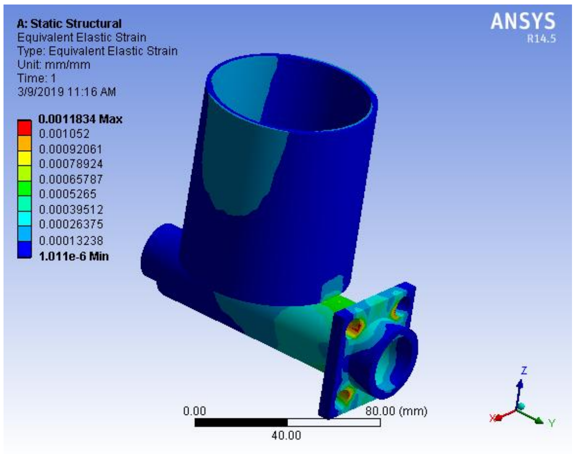

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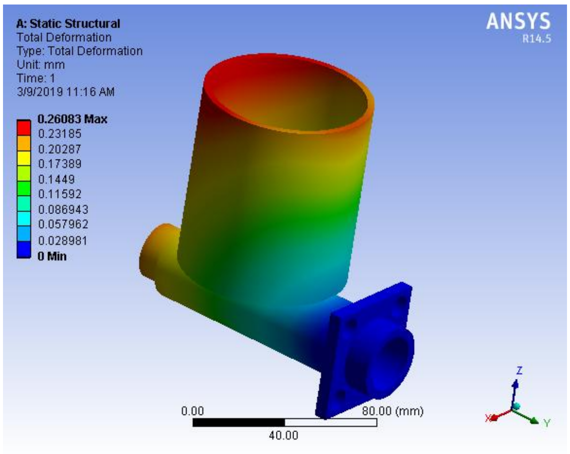

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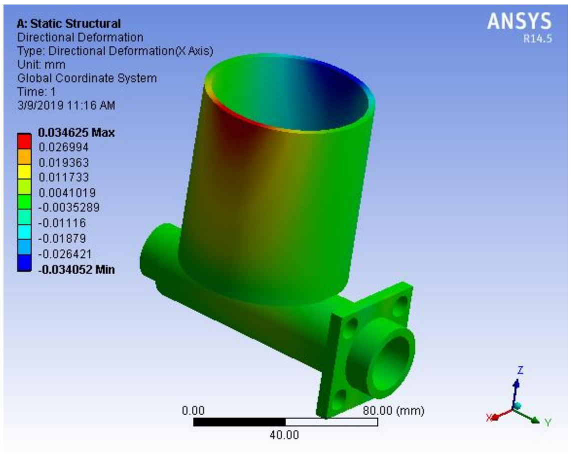
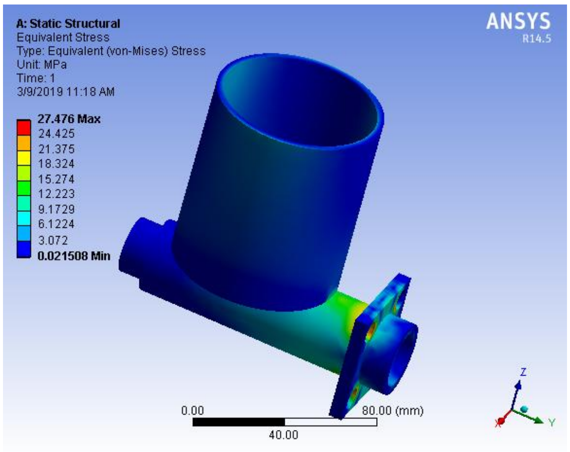


DIRECTIONAL DEFORMATION

ANSYS RESULTS FOR THE ACETYL POLYMER FOR PARAMETER 2



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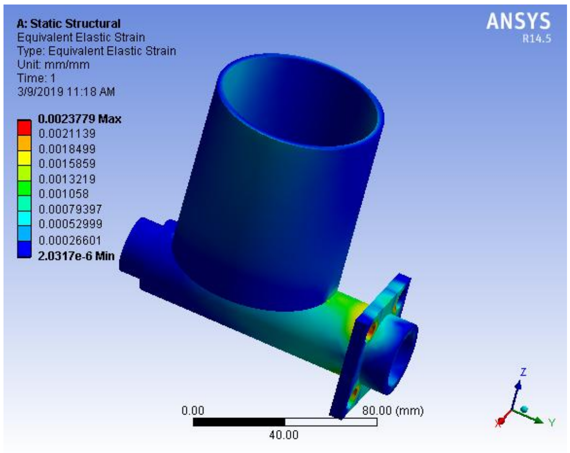

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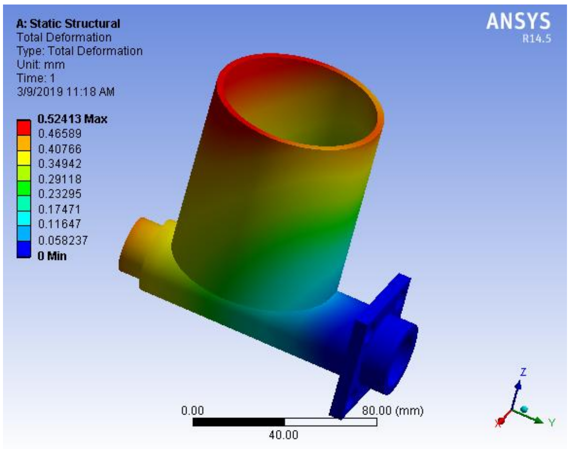

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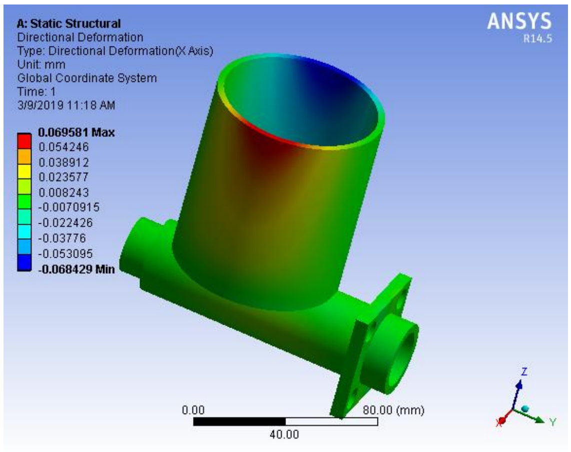

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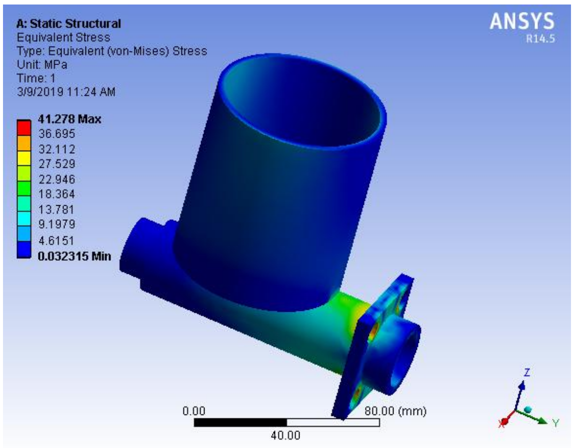
ANSYS RESULTS FOR THE ACETYL POLYMER FOR PARAMETER 3



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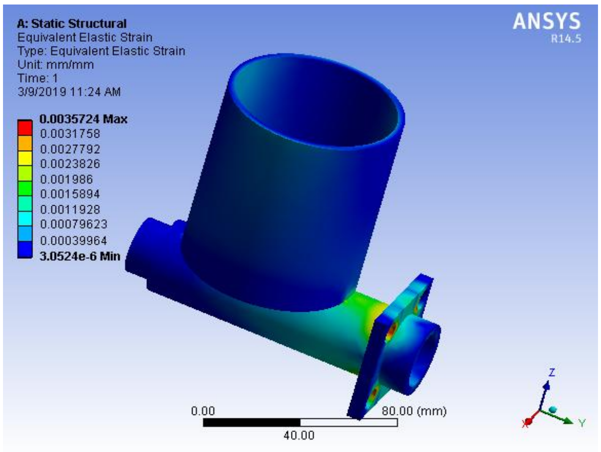

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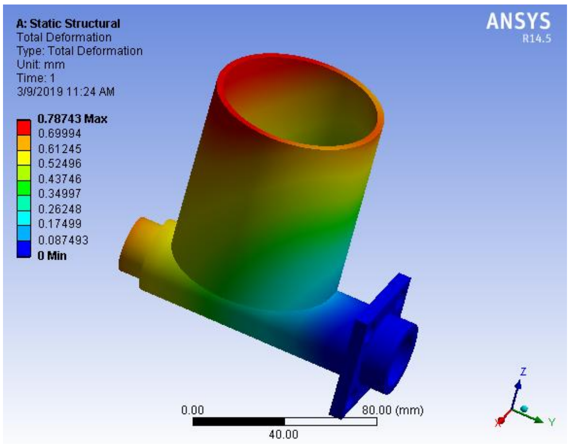

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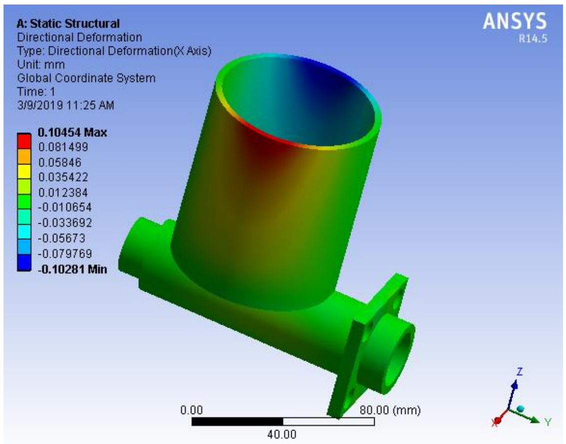
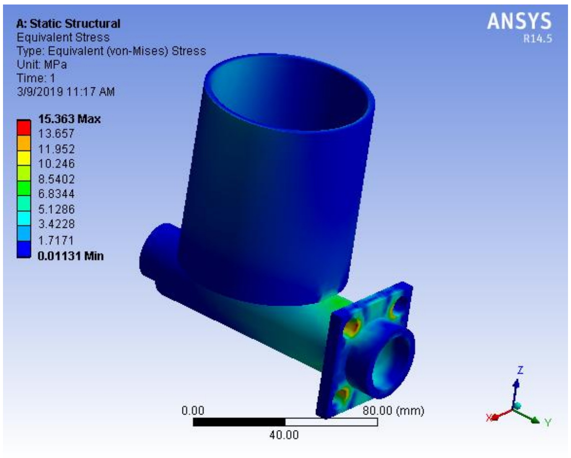


DIRECTIONAL DEFORMATION

ANSYS RESULTS FOR THE AL 2024 FOR PARAMETER 1



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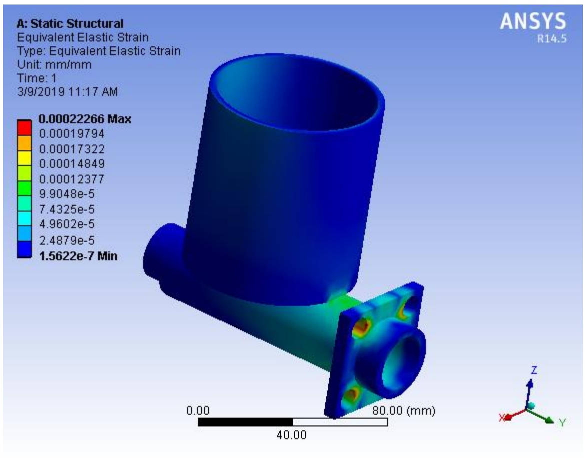

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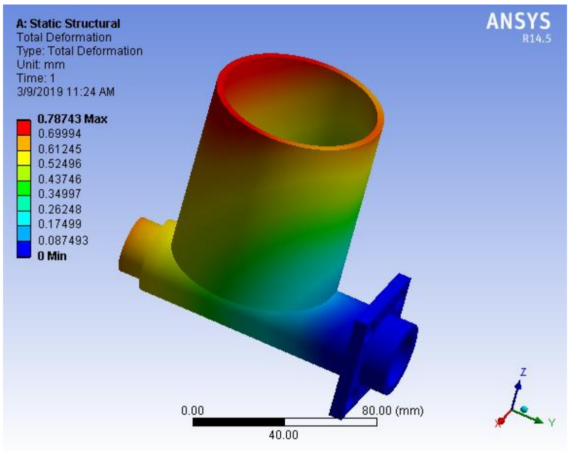

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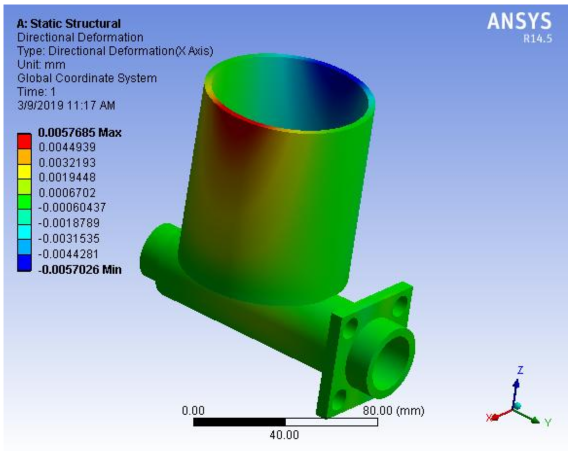
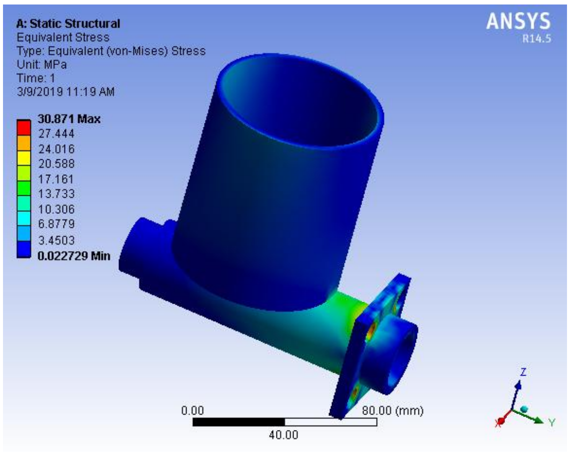


DIRECTIONAL DEFORMATION

ANSYS RESULTS FOR THE ACETYL POLYMER FOR PARAMETER 2



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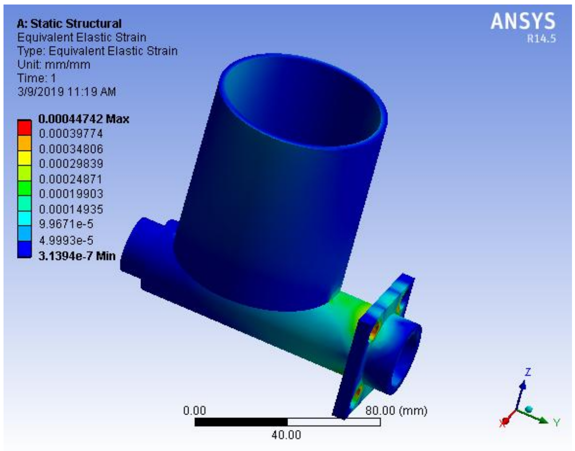

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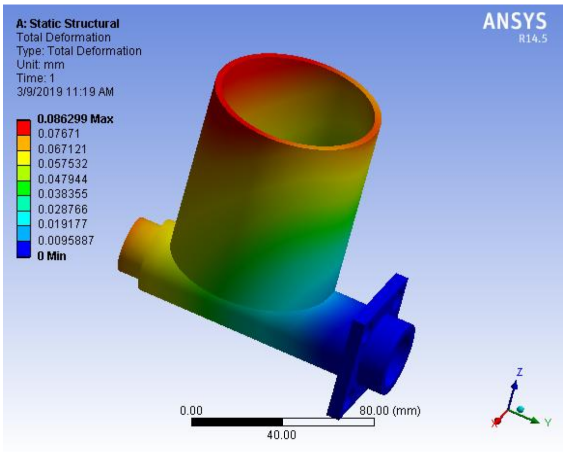

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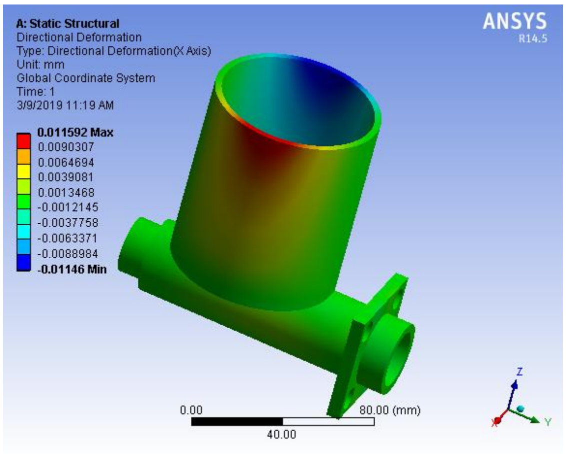
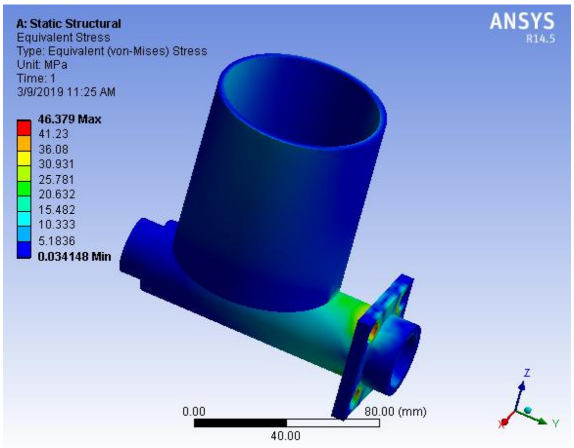


DIRECTIONAL DEFORMATION

ANSYS RESULTS FOR THE ACETYL POLYMER FOR PARAMETER 3



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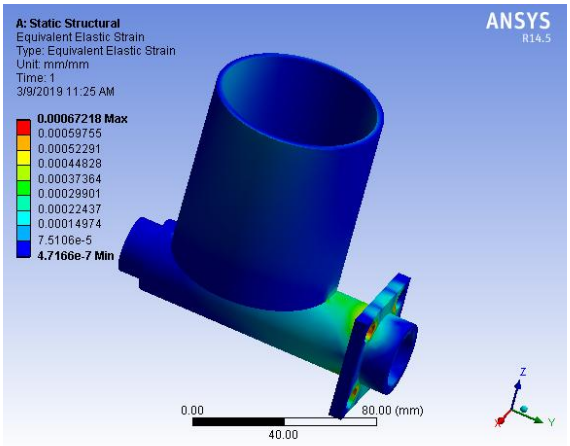

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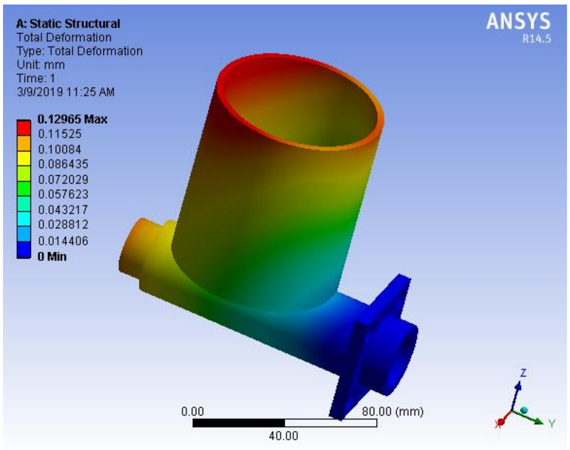

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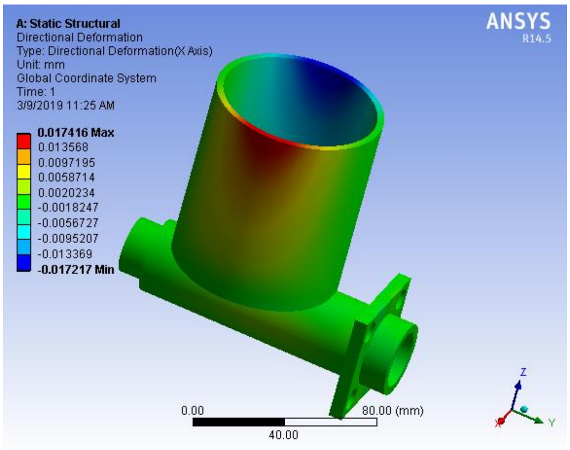

DEFORMATION

VII. RESULTS

VI.I. Results of Thermal Analysis of Master Cylinder in Tabular Form

	Parameter-1		Parameter-2		Parameter-3	
Materials	**Acetyl Polymer**	**Aluminium 2024**	**Acetyl Polymer**	**Aluminium 2024**	**Acetyl Polymer**	**Aluminium 2024**
Temperature(^{o}c)	44.799	44.799	59.805	59.805	74.81	74.81
Total Heat Flux (W/mm2)	0.0003	0.00083	0.00057	0.00158	0.00084	0.00232
Directional Heat Flux(W/mm^2)	0.00027	0.00076	0.00052	0.00145	0.00077	0.00213
Thermal Error	0.49458	0.00869	1.7754	0.0119	3.8483	0.01897

VI.I. Results of Structural Analysis of Master Cylinder in Tabular Form

	Parameter-1		Parameter-2		Parameter-3	
Materials	**Acetyl Polymer**	**Aluminium 2024**	**Acetyl Polymer**	**Aluminium 2024**	**Acetyl Polymer**	**Aluminium 2024**
Stress (MPa)	13.674	15.363	27.476	30.871	41.278	46.379
Strain (mm/mm)	0.00118	0.00022	0.00237	0.00044	0.00357	0.000672
Total Deformation (mm)	0.26083	0.0126	0.52413	0.0862	0.7874	0.12965
Directional Deformation (mm)	0.03462	0.00576	0.069581	0.011592	0.1045	0.017416

VIII. CONCLUSIONS

Here in this thesis we are going to design a master cylinder and optimization is done the stress affected areas using Catia and ANSYS software. Here even the thermal analysis is carried out to find the flux and the thermal stress using acetyl polymer and al 2024materials. Here in this thesis we have analysed the master cylinder using two materials in different parameters using structural and thermal analysis. As here in the thermal analysis if we observe the parameters considered here we can clearly spot the differences in heat flux is have the better results for the aluminium 2024 material than the acetyl polymer material. But if we verify the structural results here the stress is more for the aluminium material but the deformation is very less when compared with the acetyl polymer material. So by considering all the parameters we can conclude that the master cylinder with aluminium 2024 material has the best outputs for the chosen parameters.

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